PERSONAL ICE COOLING SYSTEM

The Need

In August and September 1997, the U.S. Department of Energy Fernald Environmental Management Project (DOE_FEMP) Office and Fluor Daniel Fernald conducted a demonstration utilizing Personal Ice Cooling System (PICS) Personnel Protective Equipment (PPE). The intent of the demonstration was to determine the PICS' ability to increase employee productivity in a heat- stress environment by maintaining core body temperature and pulse rate below health and safety threshold limits, and to improve the overall comfort of employees at risk of heat stress. While anti-contamination (Anti-Cs) PPE is designed to protect the worker from contamination, it also significantly compromises the body's ability to cool itself, leading to serious heat stress situations. For this reason, controlling heat stress is important from a project management perspective because shortened stay-times can lead to delays in D&D activities. Heat stress control is also of paramount importance from a health and safety perspective because heat stress-related illnesses are extremely serious. Current available methods of portable personal cooling are less than ideal, i.e., they don't last long enough, are heavy and require doffing of Anti-Cs to replenish cooling, and thus are not widely employed. The current heat stress program uses physiological monitoring, controlled stay-times, and use of an air-conditioned cool down room.

Figure 11. Personal Ice Cooling System, Delta Temax

The Technology

The PICS selected for demonstration at Fernald was manufactured by DELTA TEMAX, Inc. The PICS is a self-contained core body temperature control system that uses ordinary ice as a coolant and circulates cool water through tubing that is incorporated into a durable and comfortable, full body garment (pants, shirt and hood). Water is frozen in bottles that are worn outside/inside of Anti-Cs in a sealed, insulated bag, with a circulating pump attached to a support harness system. A rate adjustable, battery powered pump circulates the chilled water through the tubing in the suit. The adjustable pump allows the worker to control his temperature based upon his work load, unlike "ice vests" where the initial cooling is often extreme and uncomfortable. The ice bottle, pump, and suit make up only 12 pounds, a relatively small load.

The Demonstration

Demonstrations of the PICS took place using people from various groups on site including, hazardous waste sampling technicians from the RCRA sample line, and Radiological Control Technicians. Demonstrations of the PICS were also conducted with personnel from Wise Construction, a site sub-contractor. Data collected during the demonstrations included: pulse rate, core body temperature, stay-times, don and doff time, dry bulb ambient air temperature, type of work performed and feedback on likes and dislikes, effectiveness, ease of use, etc.

Results

The capability of the PICS to control heat stress, increase productivity, and improve worker comfort was proven with Wise Construction employees wearing the PICS during the process of rehabilitating a former thorium warehouse on site. Temperatures inside the structure reached as high as 105 ºF, with stay-times limited to 20 minutes. With the approval of all required management and health and safety professionals for the project, Wise's employees were able to extend their stay-times in the work zone to 80 minutes; a four fold increase in productivity. Pulse rate and core- body temperature were measured frequently to assess the effectiveness of the PICS' ability to maintain temperature and pulse rate below health and safety threshold limits and to ensure the safety of the employees. All measurements during the demonstration were below the set limits. Feedback from employees wearing the suits was positive, including a desire to have the PICS available for future situations where heat stress would present a problem. This demonstration is significant because the PICS has the potential to increase employee productivity and enhance the overall comfort and well-being of employees by providing effective core body temperature control.